MINERALOGY.[1]

New Instruments.

Goniometer with two Graduated Circles.—Goldschmidt[2] has devised a new form of goniometer which he has called *Goniometer mit zwei Kreisen.* Besides the horizontal graduated circle there is in this instrument a vertical graduated circle, and it is this circle which is fitted with the usual centering and adjusting support for the crystal. The vertical circle and its attachments are supported by an arm which revolves about the axis of the horizontal circle. The collimator and telescope are constructed as in the goniometer with horizontal circle, and for measurement are so placed that their axes make equal angles with the zero position of the revolving arm and movable axis. The crystal is adjusted for the prism zone and brought into the unmovable axis of the instrument. The pole of any face of a crystal is located in the same manner as a point of the earth's surface by latitude or longitude, or a star by right ascension or declination. To determine a plane *by reflection* the adjusted crystal is revolved about the movable axis (vertical circle) till the face is perpendicular to the plane of the horizontal circle (φ). The movable arm is then revolved about the unmovable axis until the face is normal to the zero position of the arm—makes equal angles with the axes of collimator and telescope (ς)—when the image of the signal will appear on the cross hairs of the telescope. The position of a plane can also be determined by the angles through which it is necessary to turn it to make it appear as a line parallel to one of the cross hairs of the telescope. The inventor claims for the instrument, among other advantages over the forms in use, that measurements are more quickly and conveniently made, and that the calculation of crystallographical constants and symbols and the making of projections are much simpler. It is necessary to mount the crystals but once for the entire measurement, and pyramid planes require but a single adjustment. The position of a face is determined without reference to the perfection of its neighbors. Angle tables can be constructed corresponding to a definite setting of the crystal which allow the symbol to be obtained at once from the angles φ and ς, and thus comparison of differently developed crystals can be easily made.

[1] Edited by Dr. Wm. H. Hobbs, University of Wisconsin, Madison, Wis.
[2] Zeitsch. f. Kryst., xxi, pp. 210–232, 1893.

Universal Goniometer.—A very similar instrument to the Goldschmidt goniometer just described is the *Universal goniometer* invented by von Federow.[3] In this instrument the telescope is also the collimator, the signal being located in the side of the telescope and its image reflected to the crystal face by means of a prism. When the face is normal to the axis of the telescope the image is reflected back over its own path and brought to a focus on the cross hairs which are located just behind the prism. The credit for priority in the important invention of the goniometer with two circles, and the method of measuring crystals by the location of the poles of their faces, clearly belongs to v. Federow, as a short description of his instrument was published in the Russian language in 1889.[4] It is impossible in this space to review so important a paper as the one under consideration. It is a treatise of some 140 pages on the calculation and projection of crystals from measurements with the universal goniometer. It contains suggestions for the renaming of crystal forms and the modification of the Miller's symbols in the interests of greater uniformity in the system.

Miers's Inverted Goniometer.—Miers[5] has modified the Fuess goniometer with horizontal circle in such a way as to have the crystal held at the lower instead of the upper end of the axis of the instrument, and hence below the disc. The crystal may be measured immersed in a liquid which is contained in a rectangular trough with plate glass sides. The collimator and telescope tubes are placed at right angles to one another, their axes being also normal to adjacent sides of the trough. The liquid in the trough may be a concentrated solution of the crystal's substance, so that changes in the form of the crystal during growth may be observed and measured. The trough is supported on a small table which can be raised or lowered at will. Some very important observations which Miers has made with this instrument will be reviewed in another place.

New Goniometer Lamp.—Goldschmidt[6] describes a new goniometer lamp which he has found useful also for photo-micrographic work. The burner is an Auer or Welsbach burner (Auer'sche Glühlicht) which is specially suited to the purpose because of its strong and

[3] Zeitsch. f. Kryst., xxi, pp. 574–714, 1893.

[4] Verhandl. k. mineral. Gesellsch. St. Petersburg, xxvi, pp. 458--460, November, 1889.

[5] Nature, l, pp. 411--412, Aug. 23, 1894.

[6] Zeitsch. f. Kryst., xxiii, pp. 149-151, 1894.

steady character and its low temperature. The burner with its glass chimney is enclosed in a cylindrical mantel constructed of brass and sheet iron, in which are inserted two horizontal tubes perpendicular to one another and at the level of the brightest part of the light. One of these tubes serves to illumine the signal, while through the medium of an arm carrying a mirror on a universal joint the light from the other tube may be thrown at will on the crystal, the vernier, or the paper.

Darkening Attachment for the Goniometer.—Traube[7] has devised a very simple attachment for the Fuess goniometer with horizontal circle by means of which the crystal under measurement is protected from all light except that which comes from the collimator. The attachment is easily adjusted and quickly removed, and is so effective that measurements may be made at any hour of the day in an undarkened room. The frequent alternation of light and darkness which is so trying to the eye can thus be avoided.

Lecture Microscope.—Fuess[8] has designed a simple form of petrographical microscope adapted to the lecture room, where it can be passed from hand to hand by the students. With full set of accessories the instrument costs in Germany 158 marks.

Czapski's Ocular.—Czapski[9] considers the attachments on petrographical microscopes which have been devised for quickly changing from parallel to convergent polarized light, as quite unnecessary complications of the instrument, since the same results can be obtained by the use of the modern iris diaphragm below the condenser. To observe the interference figure of a very small crystal which only partially covers the field of the microscope, Czapski's method is to bring the crystal as near as possible to the middle of the field, remove the ocular, and place a diaphragm with small aperture over the microscope tube. With the aid of a weak lens one sees within this aperture the real image of the crystal. The crystal is now brought more accurately to the centre so that it occupies all of the now diminished field. Removing the lens one sees the best possible interference figure from the crystal.

He has devised specially for this work an ocular with an iris diaphragm at its lower end and an easily removable lens or a Ramsden's ocular above.

[7] Neues Jahrb. f. Mineral., etc., 1894, (ii), pp. 1–2.
[8] Neues. Jahrb. f. Mineral., etc., 1894, (ii).
[9] Zeitsch. f. Kryst., xxii, pp. 158–162, 1894.

Klein's Lens with Micrometer.—Becke[10] has designed an attachment to fit over the Czapski ocular like the common form of analyzer, to determine the size of the optical angle in very small crystals when the section is approximately normal to a bisectrix (Mallard's method). This device has fitted into its upper part, so as to be adjustable by friction, an aplanatic lens magnifying eight times. Below this is an ocular micrometer which can be raised or lowered by means of two heads on the outside of the attachment. The interference figure observed with this instrument is not the one obtained by the objective alone but the one formed in the upper eye point of the microscope above the Ramsden's ocular. Before using the attachment the minute crystal is centered and the diaphragm of the Czapski ocular closed until the crystal alone is visible. The Klein lens is now adjusted over the ocular till the objective diaphragm is visible, when the interference figure may be distinctly seen. The micrometer is now adjusted to read without parallax. The constant K of the combination (in Mallard's formula $\sin\delta = K.\ d$) for a given length of tube is obtained by measuring d in the case of several sections normal to a bisectric whose optical angle has been determined by an axial angle apparatus. The attachment can also be used to measure the azimuth of any point in the interference figure with reference to cleavage or twinning line, etc. The long middle line of the micrometer is placed in the azimuth of the point to be determined. On introducing the Bertrand lens and slightly altering the length of the tube the image of the section appears. The stage is now revolved until any direction desired is brought parallel to the micrometer line and the angle measured. This device is useful to determine the changes in optical orientation in different parts of a crystal individual and to determine the position of the optic axes in the twinned lamellæ of the plagioclases.

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[10] Min. u. petrog. Mittheil., xiv, pp. 375–378, 1894.